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L

X75. Resonance in an LC Circuit; Solenoid and Light Bulb - 9F

Purpose: Show phenomenon of resonance in an LC circuit at fixed frequency (60 Hz) by varying L and C. Light bulb in the circuit lights at resonance. [Also anticipates the LCR circuit and also the 'driven LCR' circuit, both of which are presented later - could delay the demo until these covered.]

Equipment: Light bulb (120V); red solenoid (L~73 mH); variable capacitor; fat bundle of iron wire.

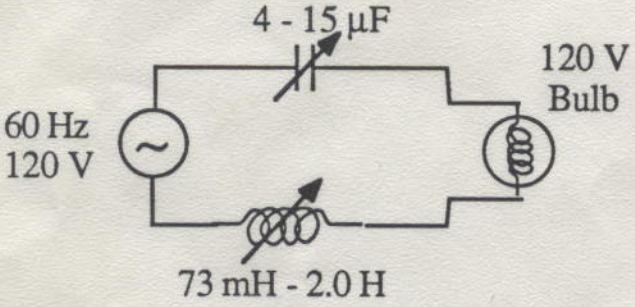
Procedure:

There is no explicit resistance in circuit (other than bulb and solenoid)
Change L by moving iron bundle in and out ; change C by turning knobs.
Light bulb lights when resonance obtained; it is off (current low) when off resonance.
Formula: $\omega_0 = 1/(LC)^{1/2}$ or $L = (\omega_0^2 C)^{-1}$
Start with rod all way in: L ~ 2.0 H and C < 4 μF (3.5 μF?) - inferred values (see below)
Set C and change L by moving rod to get resonance. Solve eqn. for L

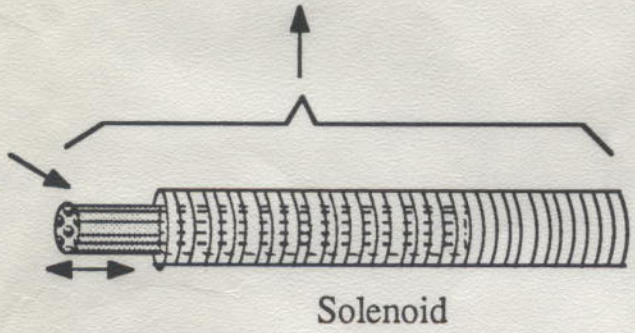
8 μF → L = 0.9 H; $L = 1/[(377)^2 \ 8 \times 10^{-6}] = 0.9$ H
10 μF → L = 0.7 H (move rod out to get this)
15 μF → L = 0.5 H (move rod out)
6 μF → L = 1.2 H (move rod in)
4 μF → L = 1.8 H (rod almost all way in)

Ref: wl video V63, tape 4, 04:53:30, 14th item of 14.

B75



X75b



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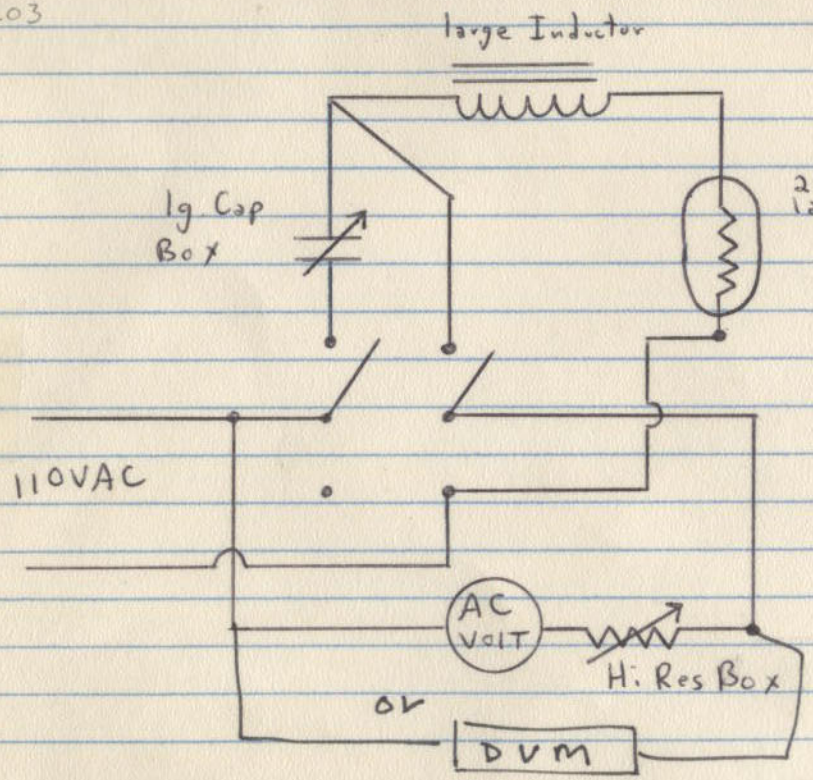
8.03

RLC RESONANCE
w/ lightbulb



Use .4uf to resonate

should be about 3:1

RLC Resonance w/ IT Bulb

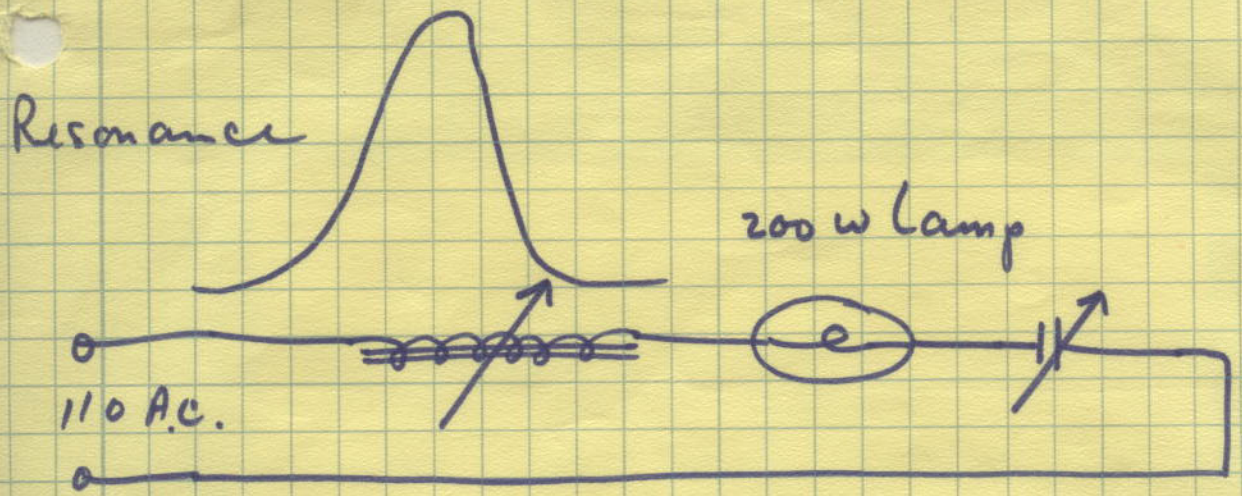
Student's Name

Date

Subject R.L.C. Circuit

Instructor's Name

L6



Inductor is variable from .1H to 1H by means of the sliding iron core. The capacitance can be fixed at 11 mfd to place resonance mid-w on the induction. Resonance can be heard (by the vibration of the iron c seen (with the lamp) and felt by the instructor when he varies the inductance value. The capacita can also be varied in 1 mfd. steps to place it on the edge of resonance and vary the lamp intensity.

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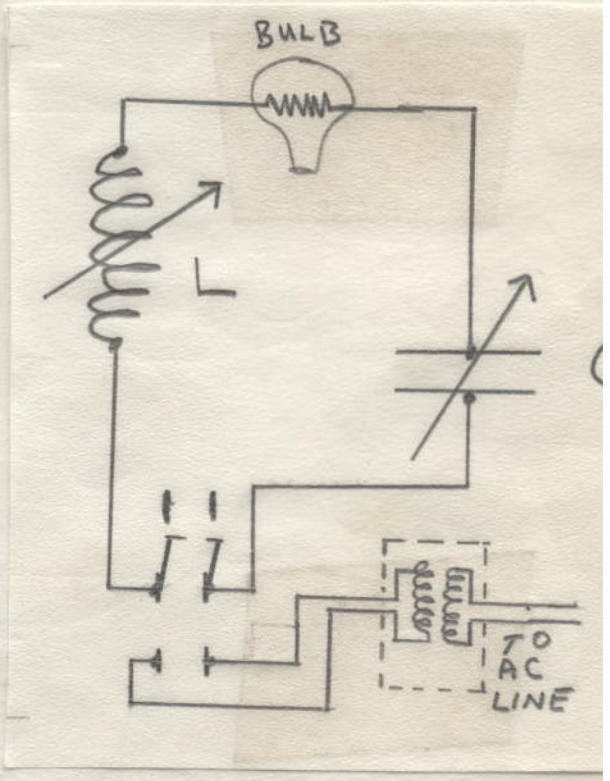
L - C CIRCUIT AND LIGHT BULB

Resonance in an LC circuit is demonstrated. A light bulb in the circuit indicates resonance (high current).



EQUIPMENT:

- LARGE RED SOLENOID WITH IRON CORE
- ~~LARGE CAPACITOR (HAS THROW SWITCHES ON TOP)~~
- ~~LIGHT BULB IN STAND~~
- ~~DPDT SWITCH~~
- ~~CABLES~~
- ISOLATION TRANSFORMER

→ USE CAPACITOR BANK, BULB & SWITCHES SHOWN IN PICTURE

SET UP:

CONNECT COMPONENTS IN SERIES. THE SWITCH IS CONNECTED TO THE AC LINE (SEE SKETCH)
THROUGH THE ISOLATION TRANSFORMER.

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OPERATION:

The resonant frequency W of an LC circuit is

$$W = 1/\sqrt{LC}$$

where L is the inductance and C is the capacitance of the circuit. In this demonstration W is fixed since we use the 60 hz AC line for the driving voltage. The inductance is varied by moving the iron core in and out of the solenoid and the capacitance is changed by opening or closing the switches on the capacitor.

a) Set rod at a position, change C to find resonance, solve for L.

Rod most of way out: C = 8 μF, L = 1.1 H

Rod all way out: C > 15 μF and L < 0.5 H

Rod all way in: C < 4 μF (3.5 μF?) and L ~ 2.0 H

$L = 1/[(377)^2\ 3.5 \times 10^{-6}] = 2.0$ H

b) Set C and change L to get resonance

10 μF → L = 0.9 H (move rod out to get this)

15 μF → L = 0.6 H (move rod out)

6 μF → L = 1.5 H (move rod in)

4 μF → L = 1.8 H (rod almost all way in)